United States Patent [19]

Reinert et al.

[11] **4,380,961**

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[54] **VARIABLY CONTROLLABLE BOBBIN THREAD PULL-OFF MECHANISM**

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[21] Appl. No.: **246,564**

[22] Filed: **Mar. 23, 1981**

[51] **Int. Cl.**[3] **D05B 57/14**; D05B 57/26

[52] **U.S. Cl.** **112/231**

[58] **Field of Search** 112/181, 182, 184, 186, 112/183, 228, 229, 231, 233, 279, 191

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,155,061	11/1964	Goebel et al.	112/228 X
3,164,113	1/1965	Ketterer	112/242
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3,693,566	9/1972	Ketterer	112/184
4,091,753	5/1978	Johnson et al.	112/184
4,182,250	1/1980	Johnson	112/184
4,215,639	8/1980	Johnson	112/242
4,232,618	11/1980	Ketterer	112/184

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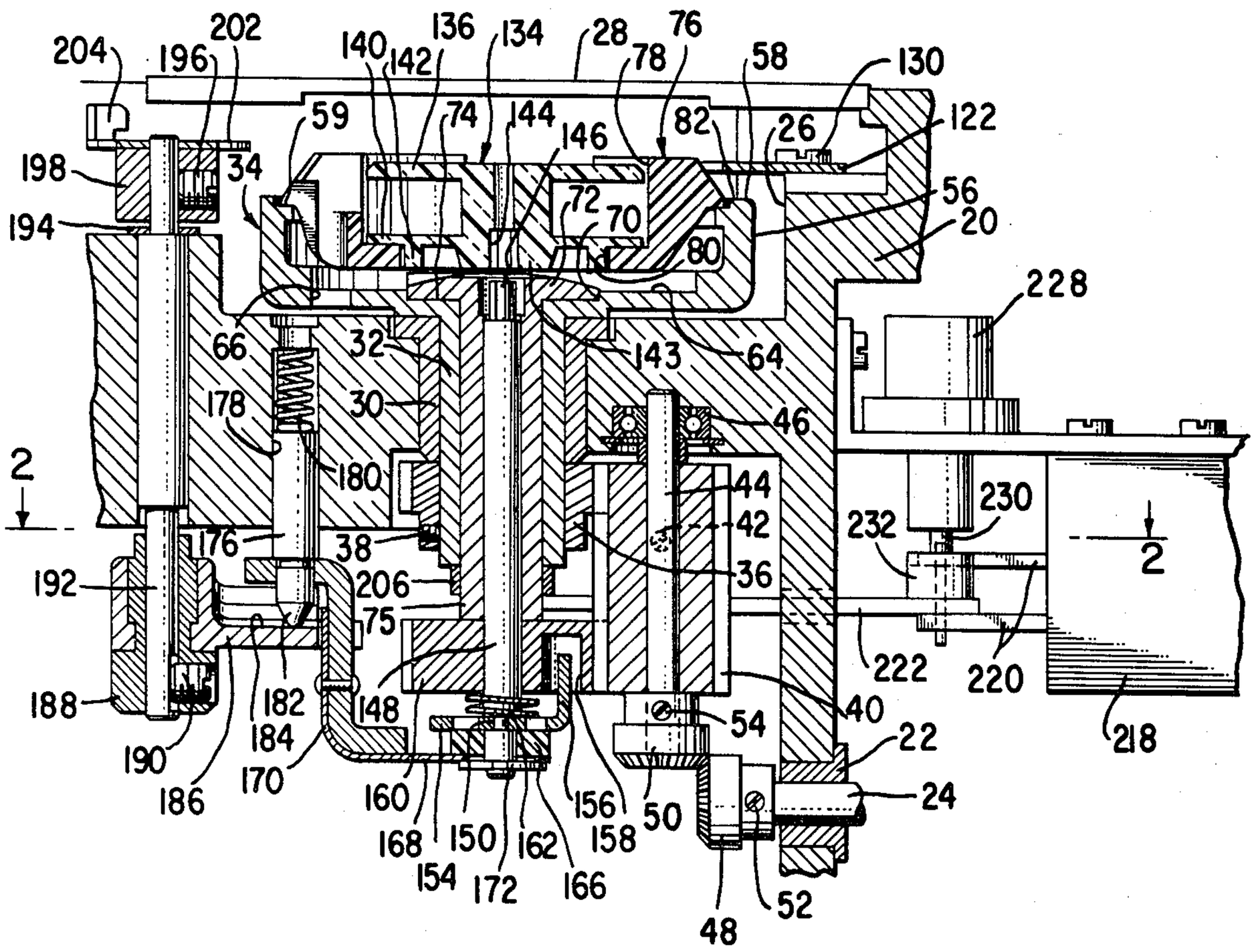
53-79647 7/1978 Japan .

Primary Examiner—Wm. Carter Reynolds
Attorney, Agent, or Firm—William V. Ebs; Robert E. Smith; Edward L. Bell

[57] **ABSTRACT**

A variable pull-off mechanism for a sewing machine is provided with a thread pull-off disc on a rotatably mounted shaft which is concentric with the drive shaft of a vertical axis looptaker. The disc is formed with thread catching edges which engage and pull-off thread from a bobbin as the disc is oscillated between a fixed and a controllable position in accordance with the operation of a servomotor responsive to various control signals.

9 Claims, 11 Drawing Figures



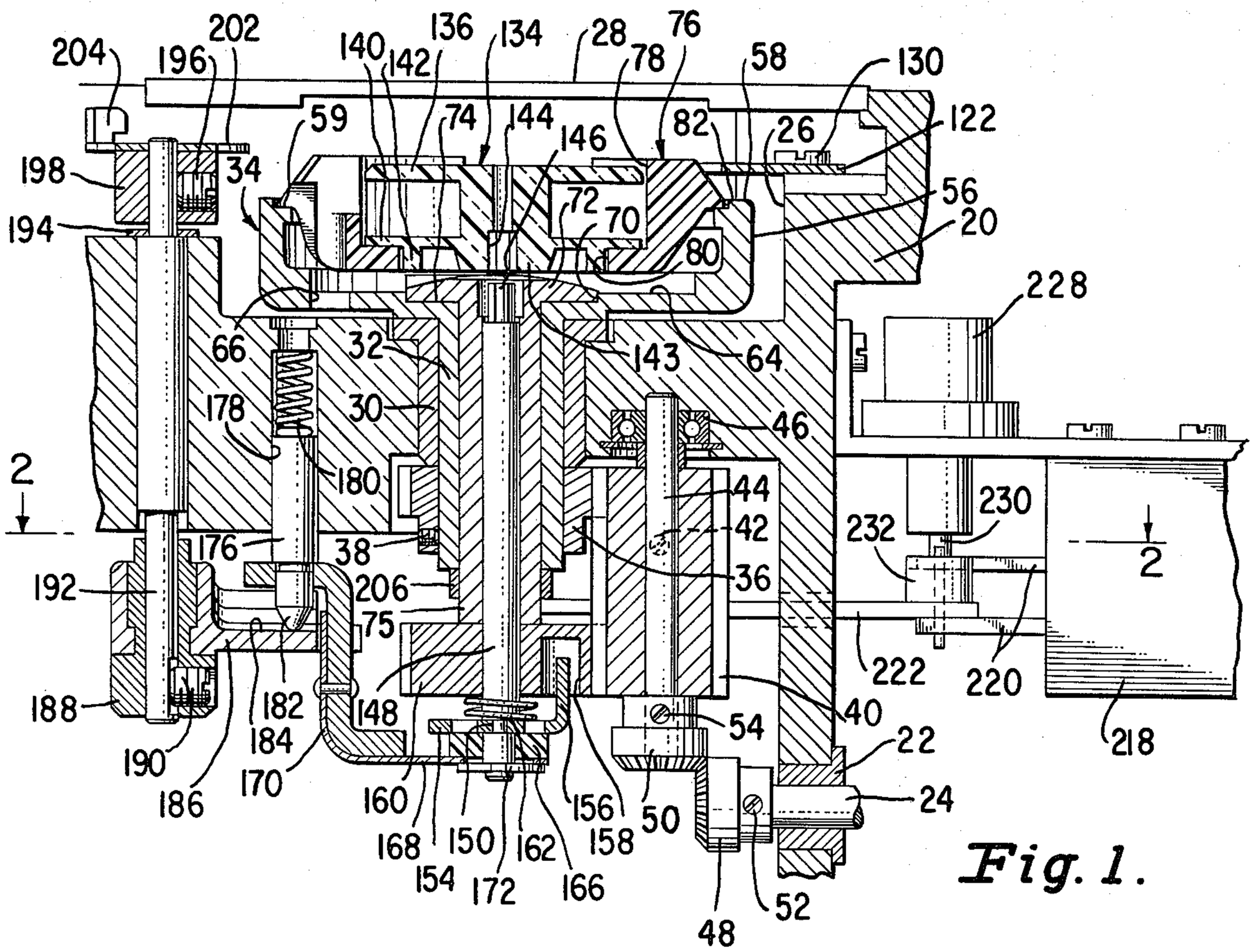

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Fig. 1.

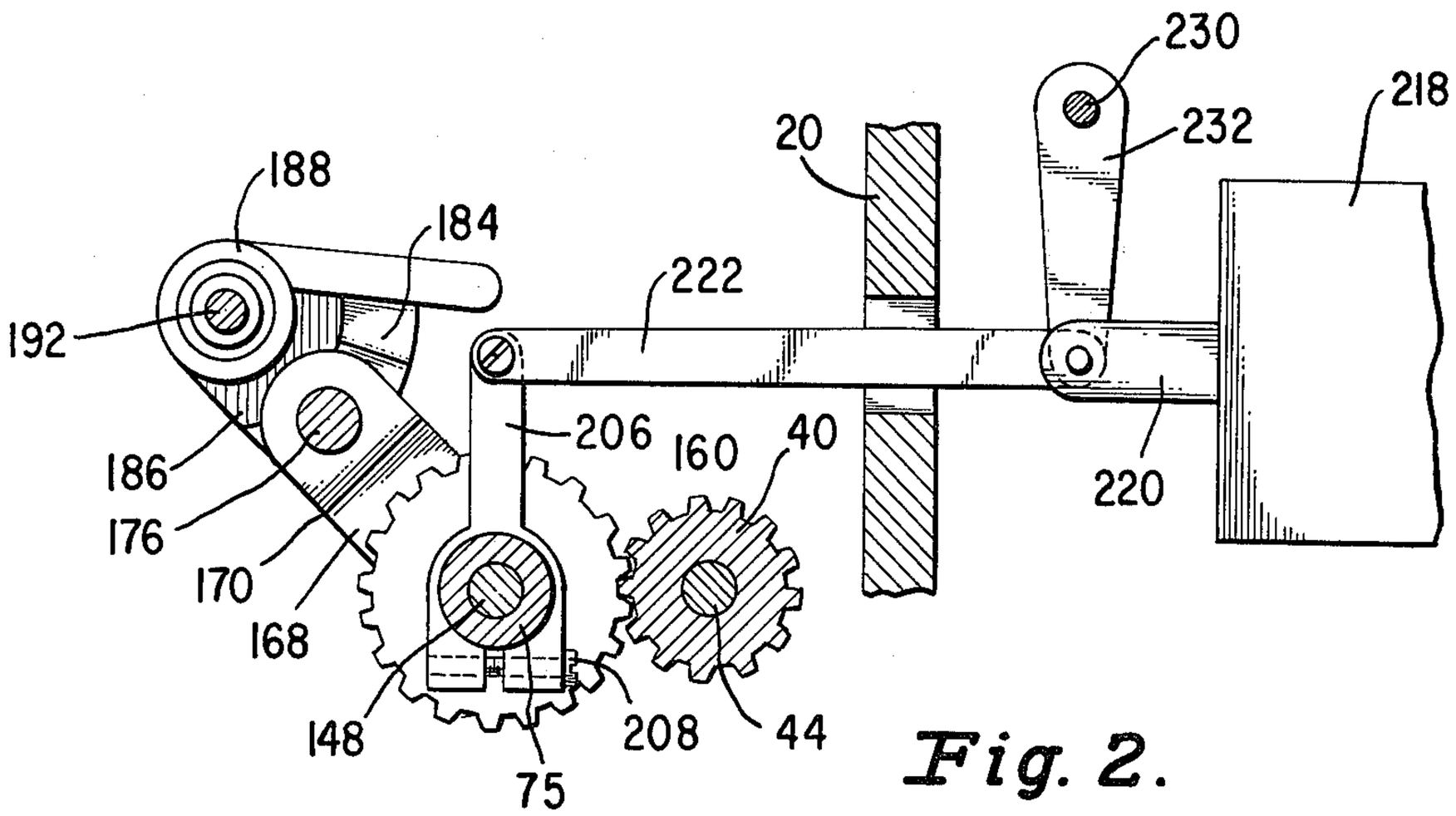
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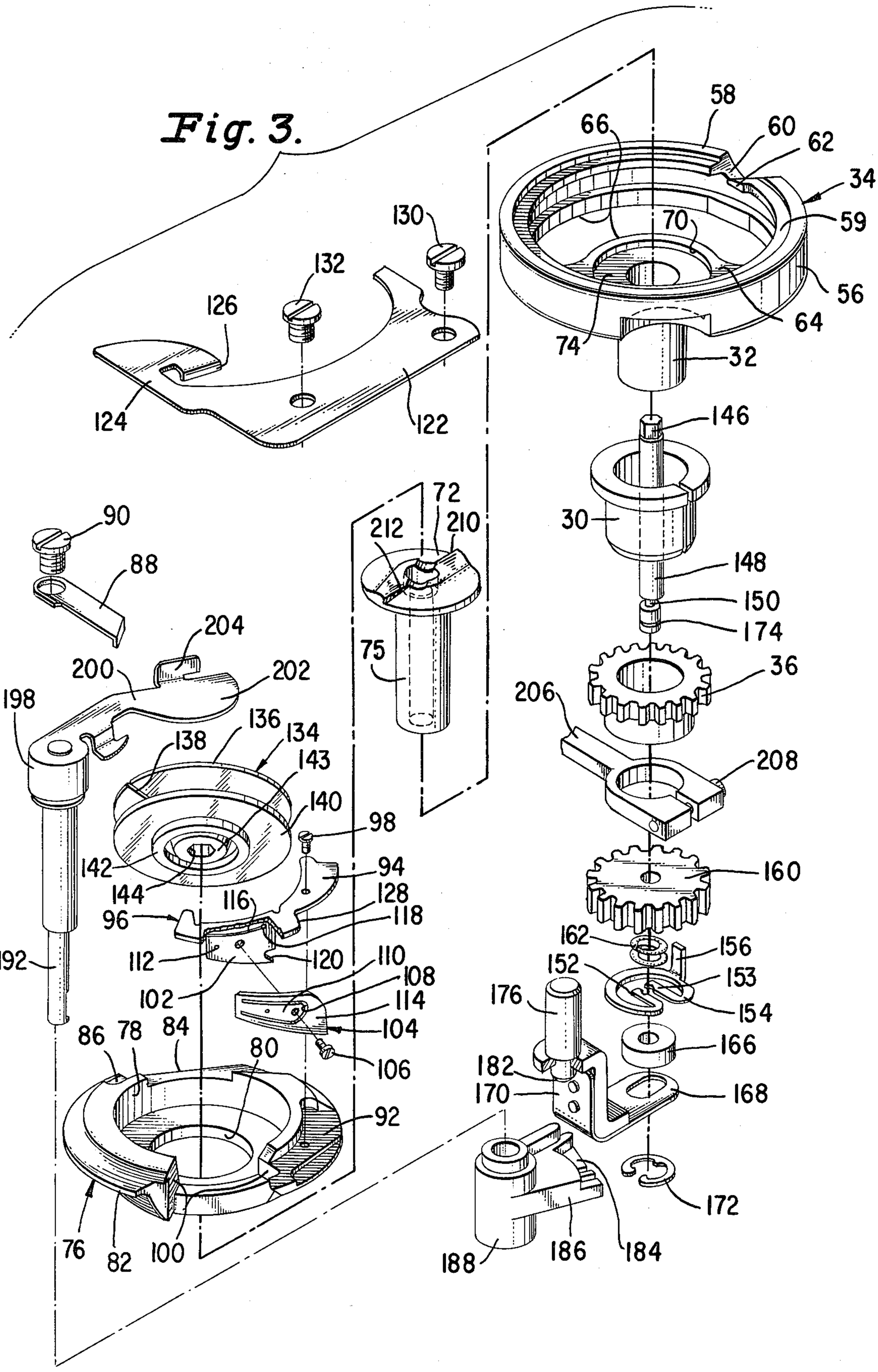
Fig. 2.

Fig. 3.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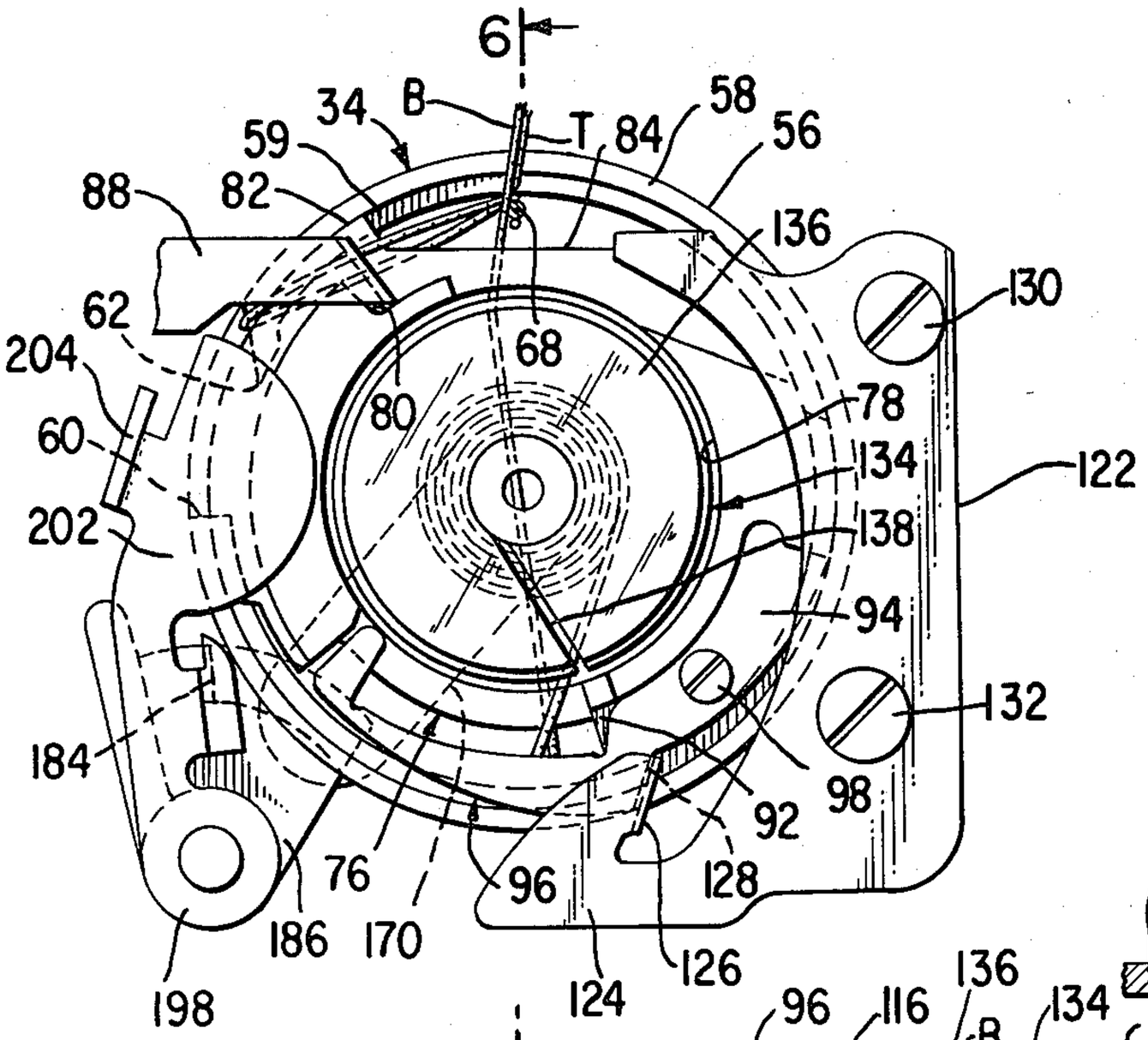


Fig. 5.

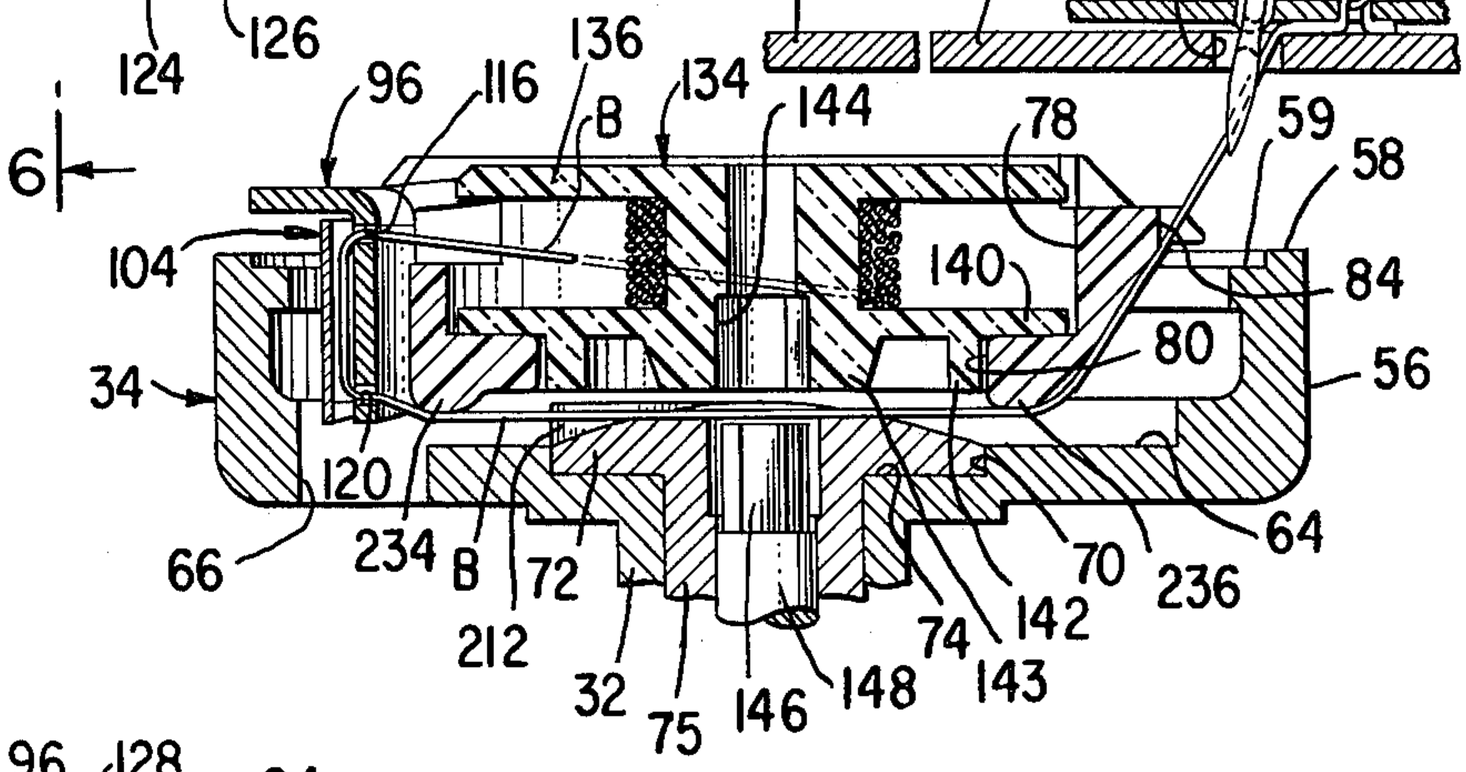
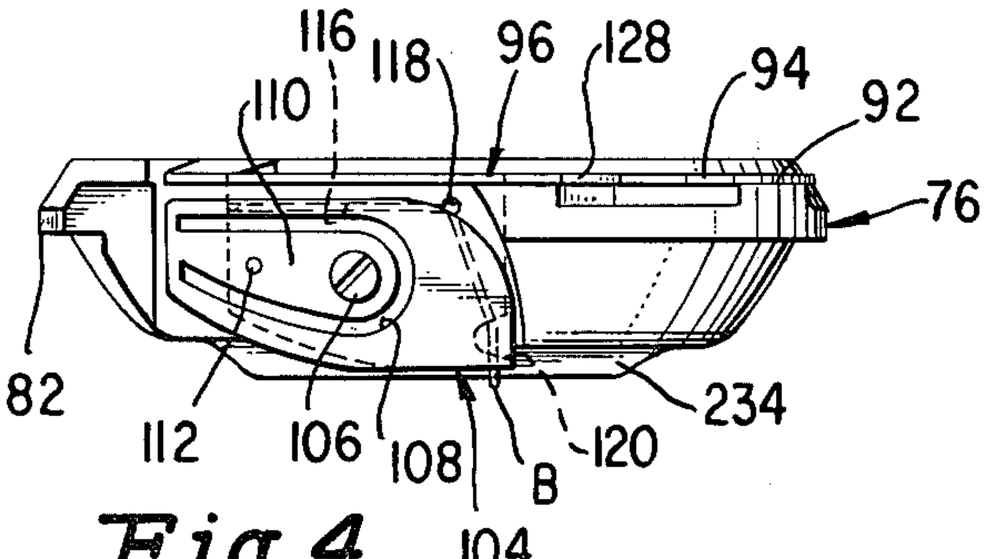


Fig. 6.



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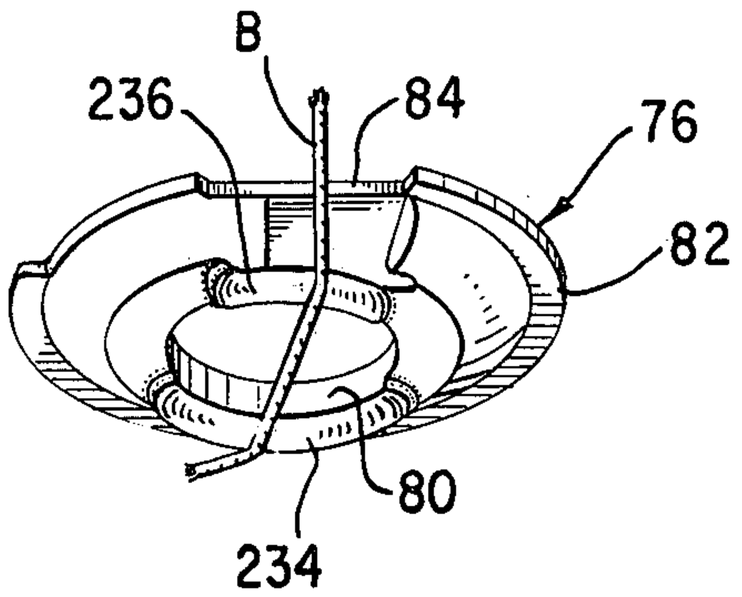


Fig. 7.

Fig. 8.

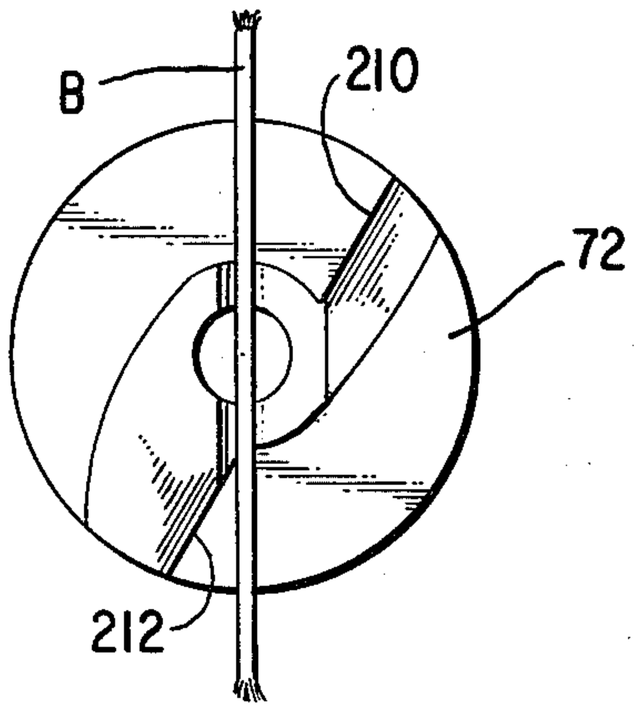
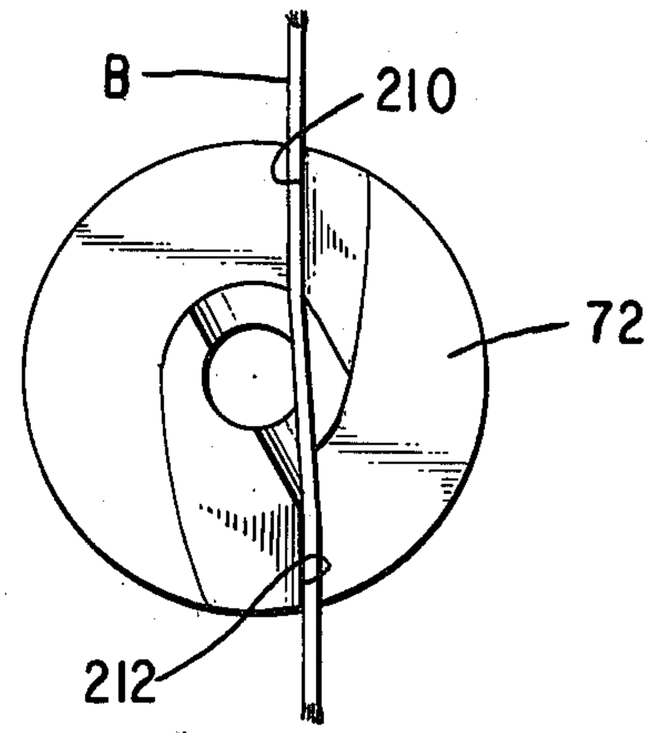


Fig. 9.



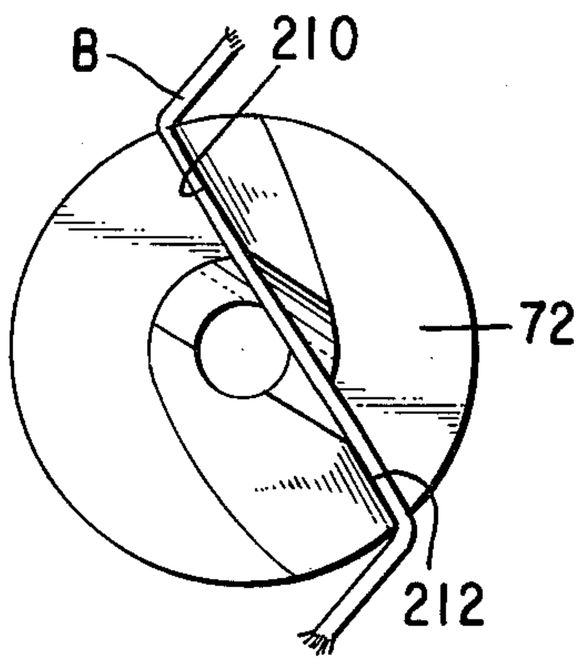


Fig. 10.

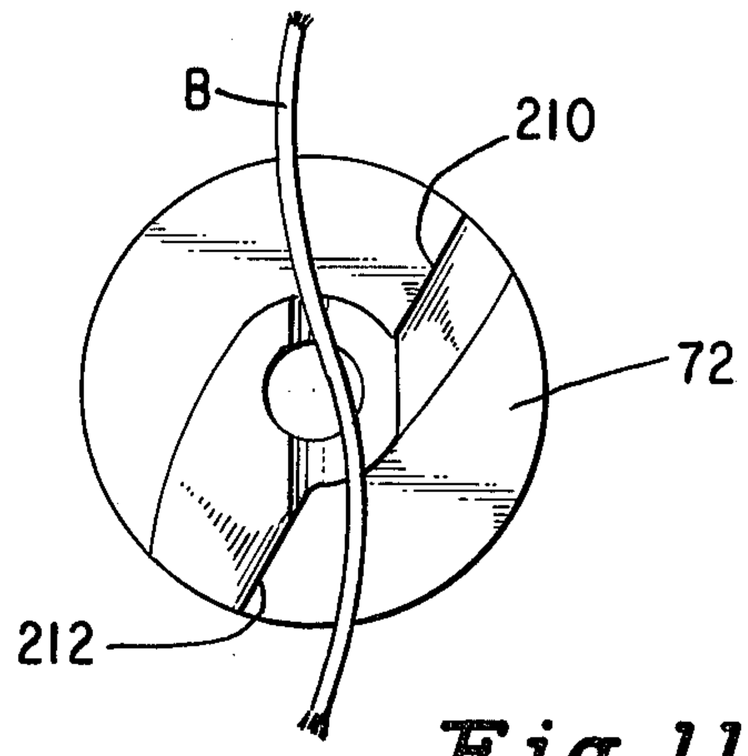


Fig. 11.

VARIABLY CONTROLLABLE BOBBIN THREAD PULL-OFF MECHANISM

DESCRIPTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to underbed thread pull-off mechanisms for use in lockstitch sewing machines, and more particularly to bobbin thread pull-off mechanisms for such use which can be variably controlled to provide for the withdrawal of suitable amounts of thread from the bobbin of a lockstitch sewing machine depending upon the particular sewing operation to be performed.

2. Description of the Prior Art

It is well known to provide a lockstitch machine with means for pulling thread from a bobbin spool for use in the formation of stitches. Most commonly, such means have been adapted to supply a constant amount of thread for each stitch regardless of the length of stitch called for, the type of stitch to be formed, or the thickness of material being sewn. However, variable operable pull-off mechanisms with which the amount of thread withdrawn from a bobbin can be changed to meet a need defined by the type of operation to be performed on a sewing machine have been devised. U.S. Pat. No. 4,215,639 of Ralph E. Johnson for "Selectively Controllable Bobbin Thread Pull-Off Mechanism," issued Aug. 5, 1980, shows such a mechanism controllable as by a servomotor responsive to signals representing a selected stitch length, a presser bar position and needle bight. Abandoned U.S. patent application of Stanley J. Ketterer for "Variable Bobbin Thread Control for Lockstitch Looptaker," Ser. No. 055847, filed July 9, 1979, and assigned to the same assignee as the present application, discloses a shiftable pull-off and retraction element on a looptaker capable of providing an effect similar to the increased or decreased pull-off of bobbin thread. U.S. Pat. No. 4,182,250 of Ralph E. Johnson for "Bobbin Thread Control Means for a Lock Stitch Sewing Machine" issued Jan. 8, 1980, discloses mechanism for pulling thread from a bobbin spool in amounts which can be predetermined by the setting of a stitch length regulator.

Stitches which are neither too tight nor too loose are more readily formed with a variably controllable bobbin thread pull-off mechanism than with a pull-off mechanism which must always supply the same amount of bobbin thread for stitches. However, the known variably controllable bobbin thread pull-off mechanisms, if not structurally complex or somewhat insensitive to input signals, are at least limited in the signals to which they are adapted to respond.

It is a prime object of the present invention to provide an improved variably controllable bobbin thread pull-off mechanism which is lacking in complexity and which can be rendered readily responsive to multiple signals.

It is another object of the invention to provide an improved variably controllable bobbin thread pull-off mechanism as described which can be mounted on a shaft concentric with the rotational axis of a looptaker.

Other objects and advantages of the invention will become apparent during a reading of the specification taken in connection with the accompanying drawings.

SUMMARY OF THE INVENTION

In accordance with the invention, a thread pulling disc is mounted on a shaft which is concentric with the drive shaft of a vertical axis looptaker of a lockstitch sewing machine, and which is operably connected with activating means for oscillating the disc between a fixed and a controllable position. The disc includes a pair of substantially radial edges which are about 180° apart. Such edges catch and pull the bobbin thread during movement of the disc from a fixed to the controllable position, and release the thread after the controllable position has been reached. A bobbin case provided for use in connection with the thread pulling disc is shaped to position the bobbin thread in the path of the disc's thread catching edges. Movements of the thread pulling disc in an assembly including the disc, looptaker and bobbin winding mechanism are selectively controllable.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a vertical sectional view taken lengthwise along a sewing machine bed through the axis of a rotary looptaker, and showing bobbin thread pull-off mechanism according to the invention;

FIG. **2** is a planar view taken substantially on the plane of the line **2—2** of FIG. **1**;

FIG. **3** is a disassembled perspective view of the looptaker and bobbin thread pull-off mechanism of the invention;

FIG. **4** is an elevational view of a bobbin case illustrating bobbin thread tensioning means with bobbin thread issuing therefrom as during sewing;

FIG. **5** is a top plan view of the looptaker of FIG. **1** together with mechanism for constraining the bobbin case in place in the looptaker and including the bobbin thread in readiness for sewing;

FIG. **6** is an enlarged cross sectional view of the looptaker taken substantially on the plane of the line **6—6** of FIG. **5**;

FIG. **7** is a bottom perspective view of the bobbin case; and

FIGS. **8** through **11** are top plan views indicating oscillatory movements of a bobbin thread pull-off disc according to the invention.

DESCRIPTION OF THE INVENTION

Referring to the drawings, reference character **20** designates the bed of a sewing machine frame carrying a bushing **22** in which a bed shaft **24** is journalled. The bed **20** is formed with an upwardly open looptaker accommodating cavity **26** closed by a slide cover plate **28**. Rotatable in a bushing **30** carried in the bed is a hollow looptaker shaft **32** which is attached by welding or the like to the underside of a looptaker indicated generally at **34** which is disposed in the cavity **26**.

The looptaker is imparted turning movement in one direction during operation of the sewing machine by a gear **36** made fast to the looptaker shaft by a set screw **38**. Gear **36** meshes with and is driven by a gear **40** affixed by a screw **42** to a shaft **44** which is rotatably mounted in a bearing **46** in bed **20**. Shaft **44** is driven by the bed shaft **24** through meshing bevel gears **48** and **50** affixed to the shafts **24** and **44** respectively by set screws **52** and **54**.

As shown, the looptaker **34** has an upwardly open cup shaped form including a rim **56** with a top edge **58**. The rim is formed with an annular inwardly extending bearing rib **59** having a lateral opening **60** formed at one

side with a needle thread loop seizing beak **62**. The looptaker includes a base **64** with an annular opening **66** providing clearance for the tip of a needle **68**. The looptaker further includes a central recess **70** wherein a bobbin thread pull-off disc **72** in accordance with the invention is supported on a shoulder **74**. As shown, the pull-off disc is integral with a hollow shaft **75** which is concentric with and extends within hollow looptaker shaft **32**.

Constrained within the cup-shaped rotary looptaker over the pull-off disc **72** is a bobbin case indicated generally at **76**. The bobbin case is formed with an upwardly open bobbin accommodating cavity **78** through the bottom of which a large control aperture **80** extends. Externally, the bobbin case includes a bearing flange **82** which is slabbed as at **84** substantially along a chord to provide clearance for the path of needle reciprocation between the bobbin case and looptaker. Adjacent to the slabbed portion **84**, the bobbin case flange **82** is formed with a shallow recess **86** which receives a rotation restraining element **88** secured by a screw **90** to the machine bed **20**. The bobbin case flange **82** is formed substantially opposite slabbed portion **84** with a recess **92** on which a support arm **94** of a bobbin thread tensioning spring bracket **96** is secured by a fastening screw **98**.

The bobbin case **76** adjacent to the recess **92** in the flange **82** is formed with a radial opening **100** across which the thread tensioning spring bracket **96** spans. A downturned arm **102** on the bracket **92** is disposed in the bobbin case radial opening **100** and provides a mounting surface against which a bobbin thread tensioning spring **104** is secured by a screw **106**. As shown the spring **104** is formed with a slot **108** in the form of a U-shaped loop separating a tongue **110** through which the securing screw **106** and a locating pin **112** on the bracket arm **102** pass. Surrounding the tongue **110** is an outer spring blade portion **114** which frictionally engages the bobbin thread against the downturned bracket arm **102** to provide the bobbin thread tension. The downturned arm **102** is formed with a thread entry slot **116** which terminates in an eyelet **118** for directing the thread to the blade portion **114** of the spring **104**. Below the spring, the downturned arm **102** is formed with a thread guiding groove **120** from which the bobbin thread leaves the spring and proceeds to a stitching point. The tension exerted on the thread by the spring blade portion **114** may be adjusted by regulating the fastening screw **106**.

For restraint of the bobbin case within the looptaker, there is provided (in addition to element **88**), a base plate **122** with a holddown arm **124** having a downturned restraining lip **126** thereon to abut a shouldered portion **128** of the support arm **94** of thread tensioning spring bracket **96**. As shown, such base plate **122** is secured to the bed **20** with screws **130** and **132**.

Within the bobbin accommodating cavity **78** of the bobbin case is a bobbin indicated generally at **134**. The bobbin is normally freely rotatable within the bobbin case. Such bobbin includes a top flange **136** formed with an outwardly extending slot **138** skewed slightly from a true radial position on the top flange. The bobbin also includes a bottom flange **140** having a depending rim **142** which fits into central aperture **80** of the bobbin case **76**, and having a depending boss **143** which is formed with a central hexagonal aperture **144** to match the hexagonal extremity **146** of a spindle **148** concentric with and extending within a hollow shaft **75**. The spindle is normally disconnected from the bobbin but is associated with bobbin thread replenishing mechanism of the kind disclosed in U.S. Pat. No. 3,693,566 of Stanley J. Ketterer for "Bobbin Thread Replenishing Mechanism for Sewing Machines" issued Sept. 26, 1972 by means of which the spindle can be raised to cause the spindle extremity **146** to enter aperture **144** and the spindle to drive the bobbin.

As shown, the spindle **148** near its lower extremity is formed with an annular groove **150** in which the opposed spring arms **152** and **153** of a friction washer **154** is snapped. The friction washer includes an upturned finger **156** which is accommodated in a notch **158** formed on the underside of a gear **160** on the spindle shaft. Gear **160** is biased upwardly on the spindle by a spring **162** located between the gear and washer **154**, and is thereby held in a position wherein the gear is against the bottom end of shaft **75** and is engaged by gear **40** which also engages gear **36** on looptaker shaft **32**. Spindle **148** is driven with the looptaker during operation of the machine by way of the friction coupling between the friction washer **154** and the spindle. Should sufficient resistance to the turning of the spindle **148** arise, the spindle may turn fully relative to the washer **154**. A driving relationship is reestablished only when the resistance to turning drops below the torque necessary to cause the friction washer to slip on the spindle **148**.

Beneath the friction washer **154** on the spindle **148** is positioned a plain washer **166** and the lateral arm **168** of an angle bracket **170**. A spring clip **172** seated in an annular notch **174** in the spindle **148** maintains the parts on the spindle. The angle bracket **170** has fastened thereto an upstanding cylindrical guide stud **176** which slides in a guide base **178** formed in the bed **20**. A coil spring **180** confined in the guide bore **178** bears against the guide stud **176** and biases the bracket **170** and spindle **148** downwardly.

The guide stud **176** extends through the angle bracket **170** and is formed beneath the angle bracket with a tapered cam follower head **182**. The cam follower head **182** tracks a cam surface **184** formed on a radial arm **186** which projects from a hub **188** secured as by a set screw **190** on the lower extremity of a fulcrum stud **192** journalled in the machine bed **20**. The fulcrum stud **192** is retained in the machine bed by a spring clip **194**, and above the machine bed has fastened thereon by a set screw **196** the hub portion **198** of a control arm **200**. The control arm **200** is formed with a blade **202** which is movable over the looptaker. A finger grip **204** is formed to extend upwardly from the blade **202** and serves for manual positioning of the control arm **200**. When the control arm is shifted in a clockwise direction the cam surface **184** acting upon the cam follower head **182** elevates the spindle to cause the hexagonal end **146** thereof to at least partially extend above thread pull-off disc and enter into a driving relationship with the bobbin **134** in hexagonal aperture **144**. The manner in which thread is wound on a rotating bobbin is fully explained in the aforementioned U.S. Pat. No. 3,693,566 and is therefor not repeated here.

As indicated hereinbefore, the thread pull-off disc **72** is integral with a shaft **75** which is mounted within hollow looptaker shaft **32**. A link **206** for imparting reciprocatory turning movements to the shaft **75** and thereby to the pull-off disc is affixed by a set screw **208** to the lower end of this shaft. The pull-off disc **72** is formed with raised edges **210** and **212** which extend substantially radially on its top surface and face in opposite directions. Such raised edges **210** and **212** on the

pull-off disc serve during sewing operations in the machine to pull thread from the bobbin for use in the formation of stitches.

During sewing operations thread B from the bobbin extends between the thread tensioning spring bracket **96** and bobbin case, into the thread guide slot **116** to eyelet **118**, and between the bracket arm **102** and thread tensioning spring blade portion **114** to the groove **120**. The bobbin thread further extends from the groove **120** beneath the bobbin case, traverses the base **64** of the looptaker and passes through needle aperture **214** in throat plate **216**. As the looptaker rotates, a loop of needle thread T is seized by the looptaker beak **62** and passed completely around the bobbin to encompass the bobbin thread which is drawn upwardly through the aperture **214** to provide for the formation of lockstitches all as fully described in U.S. Pat. No. 3,693,565 of Stanley J. Ketterer for "Lockstitch Loop Takers for Sewing Machines" issued Sept. 26, 1972.

The pull-off disc **72** is oscillated during sewing operations through a controlled angle as by a reversible linear servomotor **218** having its output shaft **220** operably connected to shaft **75** through an intermediate link **222**, and the link **206**. Servomotor **218** may be of the kind shown, for example, in U.S. Pat. No. 3,984,745. As such, the servomotor may be operated to oscillate disc **72** between a fixed position (FIG. **8** position) and a variably controllable position (FIG. **10** position) by conventional seromotor control circuitry responsive to a pulse signal for each rotation of an arm shaft of the sewing machine, and responsive to control signals representing, for example, a selected stitch length, a presser bar position, and needle bight. Reference character **228** designates a rotary potentiometer for providing a position feed back signal in such circuitry. As shown, the potentiometer shaft **230** is connected by way of a link **232** with the servomotor output shaft **220**.

Counterclockwise movement of the disc **72** from its fixed FIG. **8** position causes the raised edges **210** and **212** of the disc to engage the bobbin thread B (see FIG. **9**), engagement of the edges **210** and **212** with the bobbin thread being assured by depending formations **234** and **236** (FIG. **7**) on the bottom of the bobbin case for disposing the thread in the path of the raised edges.

Continued turning of the disc **72** in the counterclockwise direction results in bobbin thread B being pulled from the bobbin in the amount dependent upon the position attained by the disc (FIG. **10**) as determined by control signals representing, for example, stitch length, presser bar position and needle bight. The disc moves away from its FIG. **10** position in a clockwise direction and returns to the fixed position of FIG. **8** leaving slack bobbin thread (FIG. **11**) for use in the formation of stitches.

With the angular oscillatory movements of the pull-off disc timed by the pulse signals indicating complete rotational movements of the arm shaft of the machine so as to cause bobbin thread to be pulled from the bobbin between loop seizures of the needle thread T by beak **62**, and with the quantity of thread being supplied in accordance with factors such as stitch length, presser bar position and needle bight, perfect stitches may be sewn regardless of the length of stitch to be sewn, the thickness of the material being stitched and whether or not straight or zig-zag stitches are called for.

It is to be understood that the present disclosure relates to a preferred embodiment of the invention which is for purposes of illustration only, and that various modifications may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. In a sewing machine, a vertical axis looptaker including a drive shaft therefor, a non-rotatable bobbin case in the looptaker, a disc housed within the looptaker, a drive shaft for the disc concentric with the drive shaft for the looptaker, a thread carrying bobbin supported on the bobbin case for free rotation above the disc, means operably connected with the looptaker shaft for rotating the looptaker, means operably connected with the disc shaft and responsive to control input signals for causing the disc to be oscillated, between a fixed and a variably controllable position through an angle dependent upon the said signals, the disc being adapted to engage and pull thread from the bobbin according to said angle when the disc is moved in one direction, and to release the thread for use in the formation of a stitch when the disc is moved in the opposite direction.

2. The combination of claim **1** wherein the means operably connected with the disc shaft for causing oscillatory motion to be imparted to the disc includes a linear motor responsive to the said control signals.

3. The combination of claim **1** wherein the disc includes substantially radial edges for engaging and pulling thread from the bobbin.

4. The combination of claim **3** wherein said edges are substantially 180° apart.

5. The combination of claim **1** including a bobbin rewinding shaft operably connectable with the bobbin, such bobbin rewinding shaft being concentric with the disc and looptaker shafts.

6. The combination of claim **5** wherein the means for driving the looptaker shaft includes a gear on the looptaker shaft and a driving gear in engagement with the gear on the looptaker shaft, and wherein the bobbin rewinding shaft is rotatable by a gear on such shaft in engagement with the said driving gear.

7. The combination of claim **6** wherein the means operably connected with the disc shaft includes a shaft actuating member which connects with the disc shaft between the gears on the looptaker shaft and bobbin winding shaft.

8. The combination of claim **1** wherein the bobbin case is shaped to position bobbin thread for engagement by the disc.

9. The combination of claim **1** including depending formations on the bottom of the bobbin case for positioning bobbin thread for engagement by the disc.

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